Amendments to the Claims:

This listing of claims will replace all prior versions, and listings, of claims in the application:

Listing of Claims:

1. (Original) In a microfiltration membrane device, for withdrawing permeate essentially continuously from a multicomponent liquid substrate while increasing the concentration of particulate material therein, said membrane device including:

a multiplicity of hollow fiber membranes, or fibers, unconfined in a shell of a module, said fibers together having a surface area >1 m^2, said fibers being swayable in said substrate, said fibers being subject to a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi), and each fiber having a length >0.5 meter;

a first header and a second header disposed in transversely spaced-apart relationship with said second header within said substrate;

said first header and said second header having opposed terminal end portions of each fiber sealingly secured therein, all open ends of said fibers extending from a permeate-discharging face of at least one header;

permeate collection means to collect said permeate, sealingly connected in open fluid communication with a permeate-discharging face of each of said headers; and, means to withdraw said permeate;

the improvement comprising,

said fibers, said headers and said permeate collection means together forming a vertical skein wherein said fibers are essentially vertically disposed and terminal end portions of individual fibers are potted in proximately spaced-apart relationship in cured resin;

said first header being upper and disposed in vertically spaced-apart relationship above said second header, with opposed faces at a fixed distance;

each of said fibers having substantially the same length, said length being from 0.1% to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber.

2. (Original) The membrane device of claim 1 wherein each said header is a mass of synthetic resinous material in which said terminal end portions are potted and said fibers are formed from an organic resinous material or a ceramic.

3. (Original) The membrane device of claim 2 wherein each said hollow fiber has an outside diameter in the range from about 20 μm to about 3 mm, a wall thickness in the range from about 5 μm to about 2 mm, and, said fiber is formed from a material selected from the group consisting of natural and synthetic polymers, and pore size in the range from 1000 Å to 10000 Å, and, said displacement is in the lateral or horizontal direction.

4. (Original) The membrane device of claim 3 wherein said transmembrane pressure differential is in the range from 3.5 kPa (0.5 psi) to about 175 kPa (25 psi), said fibers are in the range from 0.5 m to 5 m long, and said terminal end portions of said fibers are potted within said mass of thermosetting synthetic resinous material to a depth in the range from about 1 cm to about 5 cm.

5. (Original) The membrane device of claim 3 wherein said substrate is maintained at a pressure in the range from about 1-10 atm, said fibers extend as a skein upwardly from a fiber-supporting face of each of said headers, each header is a rectangular prism having substantially the same dimensions, said fibers extend downwardly through the permeate-discharging face of said headers, and said permeate is discharged upwardly relative to said upper header.

6. (Original) The membrane device of claim 4 wherein said terminal end portions of said fibers are potted within a mass of thermosetting synthetic resinous material to a

depth in the range from about 1 cm to about 5 cm and protrude through a permeate-discharging face of each said header in a range from about 0.1 mm to about 1 cm.

7. (Original) The membrane device of claim 6 wherein said open ends of fibers are bounded by a geometrically regular peripheral boundary around the outermost peripheries of the outermost fibers in the boundary, and the length of a fiber is essentially independent of the strength of said fiber, or its diameter.

8. (Original) The membrane device of claim 7 wherein said fibers together have a surface area in the range from 10 to 10^3 m^2.

9. (Original) The membrane device of claim 8 wherein said first and second headers are each a rectangular parallelpiped and said first header is disposed parallel to said second header.

10. (Original) In a gas-scrubbed assembly comprising, a microfiltration membrane device in combination with a gas-distribution means to minimize build-up of particulate deposits on the surfaces of hollow fiber membranes ("fibers") in said device, and to recover permeate from a multicomponent liquid substrate while leaving particulate matter therein, said membrane device comprising,

a multiplicity of fibers, unconfined in a shell of a module, said fibers together having a surface area >1 m^2, said fibers being swayable in said substrate, said fibers being subject to a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi), and each having a length >0.5 meter;

a first and second header disposed in spaced-apart relationship within said substrate;

said first header and said second header having opposed terminal end portions of each fiber sealingly secured therein, all open ends of said fibers extending from a permeate-discharging face of at least one header;

permeate collection means to collect said permeate, sealingly connected in open fluid communication with a permeate-discharging face of each of said headers; and,

means for withdrawing said permeate; and,

said gas-distribution means is located within a zone near the base of said skein, having through-passages therein adapted to have sufficient gas flowed therethrough to generate enough bubbles flowing in a column of rising bubbles through and around said skein fibers, to keep surfaces of said fibers awash in bubbles;

the improvement comprising,

said fibers, said headers and said permeate collection means together forming a skein wherein said fibers are essentially vertically disposed and terminal end portions of individual fibers are potted in proximately spaced-apart relationship in cured resin;

said first header being upper and disposed in vertically spaced-apart relationship above said second header at a fixed distance;

each of said fibers having substantially the same length, said length being from at least 0.1% greater, to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber; and,

said gas distribution means having through-passages therein to discharge a cleansing gas in an amount in the range from 0.47-14 cm^3/sec per fiber (0.001 scfm/fiber to about 0.03 scfm/fiber) in a column of bubbles which rise vertically substantially parallel to, and in contact with said fibers, movement of which is restricted within said column;

whereby said permeate is essentially continuously withdrawn while concentration of said particulate matter in said substrate is increased.

11. (Original) The gas-scrubbed assembly of claim 10 wherein said fixed distance is adjustable, said gas-distribution means includes at least two distribution means disposed, one on each side of said skein, said gas-distribution means generate bubbles having an average diameter in the range from about 0.1 mm to about 25 mm which

bubbles contact said fibers, maintain their buoyancy, and maintain said fibers' outer surfaces essentially free from build-up of deposits of said particulate matter.

12. (Original) The gas-scrubbed assembly of claim 11 wherein said through-passages in said gas-distribution means generate bubbles in the size range from 1 mm to 25 mm in relatively close proximity, in the range from 1 cm to about 50 cm, to said through-passages.

13. (Original) The gas-scrubbed assembly of claim 10 wherein said fibers have pores in the size range from about 1000 Å to 10000 Å, each said header is a rectangular prism having substantially the same dimensions, said gas is an oxygen-containing gas, and said particulate matter comprises biologically active microorganisms growing in said substrate.

14. (Original) The gas-scrubbed assembly of claim 10 wherein said particulate matter comprises finely divided inorganic particles.

Claims 15-22 (Cancelled)

23. (Previously Presented) In a microfiltration membrane device, for withdrawing permeate essentially continuously from a multi-component liquid substrate while increasing the concentration of particulate material therein, said membrane device including:

a multiplicity of hollow fiber membranes, or fibers, unconfined in a shell of a module, said fibers together having a surface area > 1 m^2, said fibers being swayable in said substrate, said fibers being subject to a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi), and each fiber having length > 0.5 meter;

a first header and a second header disposed in transversely spaced-apart relationship with said second header within said substrate;

a first header and a second header having opposed terminal end portions of each fiber sealingly secured therein, all open ends of said fibers extending from a permeate-discharging face of at least one header;

permeate-collection means to collect said permeate, sealingly connected in open fluid communication with a permeate-discharging face of each of said headers; and,

means to withdraw said permeate;

the improvement comprising,

said fibers, said headers and said permeate collection means together forming a vertical skein wherein said fibers are essentially vertically disposed and terminal end portions of individual fibers are potted in proximately spaced-apart relationship in cured resin;

said first header being upper and disposed in vertically spaced-apart relationship above said second header, with opposed faces at a fixed distance;

each of said fibers having substantially the same length, said length being from between 0.1% to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber; and,

a gas distribution system having through-passages adapted to discharge bubbles near to rise through or around the skein of fibers, the gas distribution system including one or more gas tubes which space the first and second headers apart and which also carry air to the through-passages.

24. (Previously Presented) The device of claim 23 wherein the upper and lower headers are cylindrical and the one or more gas tubes are a single gas tube located in about the center of the headers.

25. (Previously Presented) In a microfiltration membrane device, for withdrawing permeate essentially continuously from a multi-component liquid substrate while increasing the concentration of particulate material therein, said membrane device including:

a multiplicity of hollow fiber membranes, or fibers, unconfined in a shell of a module, said fibers together having a surface area > 1 m^2, said fibers being swayable in said substrate, said fibers being subject to a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi), and each fiber having length > 0.5 meter;

a first header and a second header disposed in transversely spaced-apart relationship with said second header within said substrate;

a first header and a second header having opposed terminal end portions of each fiber sealingly secured therein, all open ends of said fibers extending from a permeate-discharging face of at least one header;

permeate-collection means to collect said permeate, sealingly connected in open fluid communication with a permeate-discharging face of each of said headers; and,

means to withdraw said permeate;

the improvement comprising,

said fibers, said headers and said permeate collection means together forming a vertical skein wherein said fibers are essentially vertically disposed and terminal end portions of individual fibers are potted in proximately spaced-apart relationship in cured resin;

said first header being upper and disposed in vertically spaced-apart relationship above said second header, with opposed faces at a fixed distance;

each of said fibers having substantially the same length, said length being from between 0.1% to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber, wherein the headers are rectangular in plan view and the skein has about 30 or less arrays of fibers.

26. (Previously Presented) A device for withdrawing permeate from a multicomponent liquid substrate comprising,

(a) a reservoir under essentially ambient pressure having a feed zone for containing a substrate;

(b) a microfiltration membrane device, for withdrawing permeate essentially continuously from the multi-component liquid substrate while increasing the concentration of particulate material therein, said membrane device including:

a multiplicity of hollow fiber membranes, or fibers, unconfined in a shell of a module, said fibers together having a surface area > 1 m^2, said fibers being swayable in said substrate, said fibers being subject to a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi), and each fiber having length > 0.5 meter;

a first header and a second header disposed in transversely spaced-apart relationship with said second header within said substrate;

a first header and a second header having opposed terminal end portions of each fiber sealingly secured therein, all open ends of said fibers extending from a permeate-discharging face of at least one header;

permeate-collection means to collect said permeate, sealingly connected in open fluid communication with a permeate-discharging face of each of said headers; and,

means to withdraw said permeate;

said fibers, said headers and said permeate collection means together forming a vertical skein wherein said fibers are essentially vertically disposed and terminal end portions of individual fibers are potted in proximately spaced-apart relationship in cured resin;

said first header being upper and disposed in vertically spaced-apart relationship above said second header, with opposed faces at a fixed distance;

each of said fibers having substantially the same length, said length being from between 0.1% to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber,

the outside of the membranes in fluid communication with the feed zone of the reservoir;

(c) a pump in fluid communication with the insides of the membranes through the permeate collection means, the pump operable to supply a suction to the lumens of the hollow fiber membranes to draw permeate through the membranes; and,

(d) a gas distribution means including a plurality of through-passages for discharging bubbles which rise and contact fibers.

27. (Previously Presented) The device of claim 26 wherein at least some of the through-passages have outlets located within the skein.

28. (Previously Presented) The device of claim 26 wherein the headers are rectangular in plan view and have about 30 arrays or less of fibers and the outlets of the through-passages are located to the side of the headers.

29. (Previously Presented) In a microfiltration membrane device, for withdrawing permeate essentially continuously from a multi-component liquid substrate while increasing the concentration of particulate material therein, said membrane device including:

a multiplicity of hollow fiber membranes, or fibers, unconfined in a shell of a module, said fibers together having a surface area >1 m^2, said fibers being swayable in said substrate, said fibers being subject to a transmembrane pressure differential in the range from about 0.7 kPa (0.1 psi) to about 345 kPa (50 psi), and each fiber having length > 0.5 meter;

a first header and a second header disposed in transversely spaced-apart relationship with said second header within said substrate;

a first header and a second header having opposed terminal end portions of each fiber sealingly secured therein, all open ends of said fibers extending from a permeate-discharging face of at least one header;

permeate-collection means to collect said permeate, sealingly connected in open fluid communication with a permeate-discharging face of each of said headers; and,

means to withdraw the permeate;

the improvement comprising,

said fibers, said headers and said permeate collection means together forming a vertical skein wherein said fibers are essentially vertically disposed and terminal end portions of individual fibers are potted in proximately spaced-apart relationship in cured resin;

said first header being upper and disposed in vertically spaced-apart relationship above said second header, with opposed faces at a fixed distance:

each of said fibers having substantially the same length, said length being from between 0.1% to less than 5% greater than said fixed distance so as to permit restricted displacement of an intermediate portion of each fiber, independently of the movement of another fiber;

walls extending downwards from a lower header of the first and second header, the walls being adapted to retain a gas below the lower header; and,

through-passages for gas to pass through the lower header from an area below the lower header bordered by the walls.

30. (Previously Presented) The device of claim 29 wherein the through passages are located such that gas flowing from the area below the lower header bordered by the walls, exits between fibers.

31. (New) The membrane device of claim 1 wherein said fibers, said headers and said permeate collection means are all submersible below the surface of the substrate.

32. (New) The membrane device of clam 31 further comprising a manifold for withdrawing permeate, the manifold extending from the permeate collection means to a point above the surface of the substrate.

33. (New) The membrane device of claim 31 wherein the permeate collection means further comprises a pan or header enclosure covering each permeate discharging face.

34. (New) A membrane filtration system comprising:

(a) a tank for holding a substrate at ambient pressure during filtration;

(b) a membrane device according to claim 1 immersed below the surface of the substrate;

(c) an aeration system for producing bubbles in the substrate which contact the fibers; and,

(d) a source of suction in fluid communication with the membrane filtration device.

35. (New) The membrane filtration system of claim 34 further comprising a backwashing system for backwashing the membrane filtration device with a liquid.